AGENȚIA DE STAT PENTRU PROPRIETATEA INTELECTUALĂ A REPUBLICII MOLDOVA

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RESISTIVE SENSOR FOR RELATIVE HUMIDITY

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ASSIGNEE: National Institute for Research and Development in Microtechnologies - IMT Bucharest

Inventors:
BOGDAN-CĂTĂLIN ŞERBAN, OCTAVIAN BUIU, CORNEL COBIANU

INTRODUCTION

RH sensors have received increasing attention in the last years due to their importance in a large variety of residential, industrial, and commercial applications. One can mention some of those: controlling and sensing humidity in offices and homes, medical field (gas supply infrastructure, incubators, sterilizers), food/beverage processing, chemical industry (dehumidifiers, smelting furnaces, dryers), pharmaceutical processing, electronics (semiconductor fabrication plants, clean room controls) agriculture (drip irrigation), weather station, textile, and paper industry, automotive industry (engine tests beds).

ORIGINAL APPROACH

This patent application refers to the development of resistive relative humidity (RH) sensor, employing a sensing layer based on a binary nanocomposite comprising oxidized carbon nanohorns (CNHox) (Fig.1) – tannic acid (Fig.2), oxidized carbon nanoonions (CNOox)) (Fig.3)- tannic acid or ternary nanocomposite comprising oxidized carbon nanohorns (CNHox), oxidized carbon nanoonions (CNOox) and tannic acid.

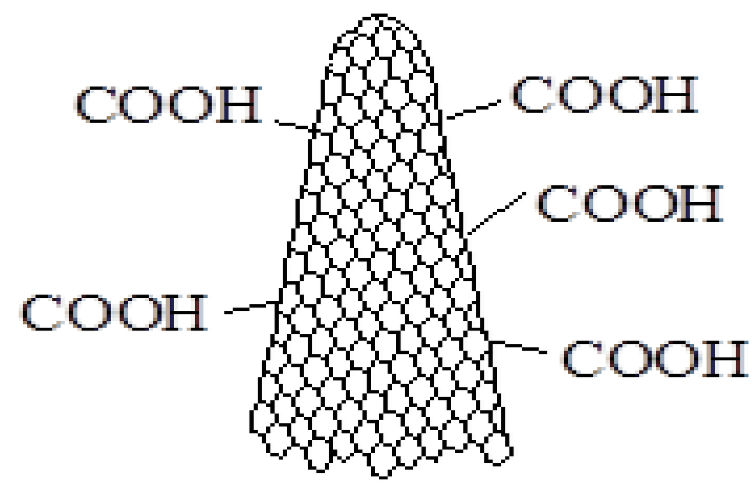

Fig. 1 – Structure of oxidized carbon nanohorns (CNH_{OX})

The RH sensor includes a Si/SiO_2 substrate, interdigitated electrodes and a sensing layer obtained via spin coating method. The RH monitoring capability of the sensing layers was investigated by applying a current between the two electrodes and measuring the voltage at different values of the oxygen concentration at which the sensing layer was exposed. The resistance of the sensitive layer varies with RH level.

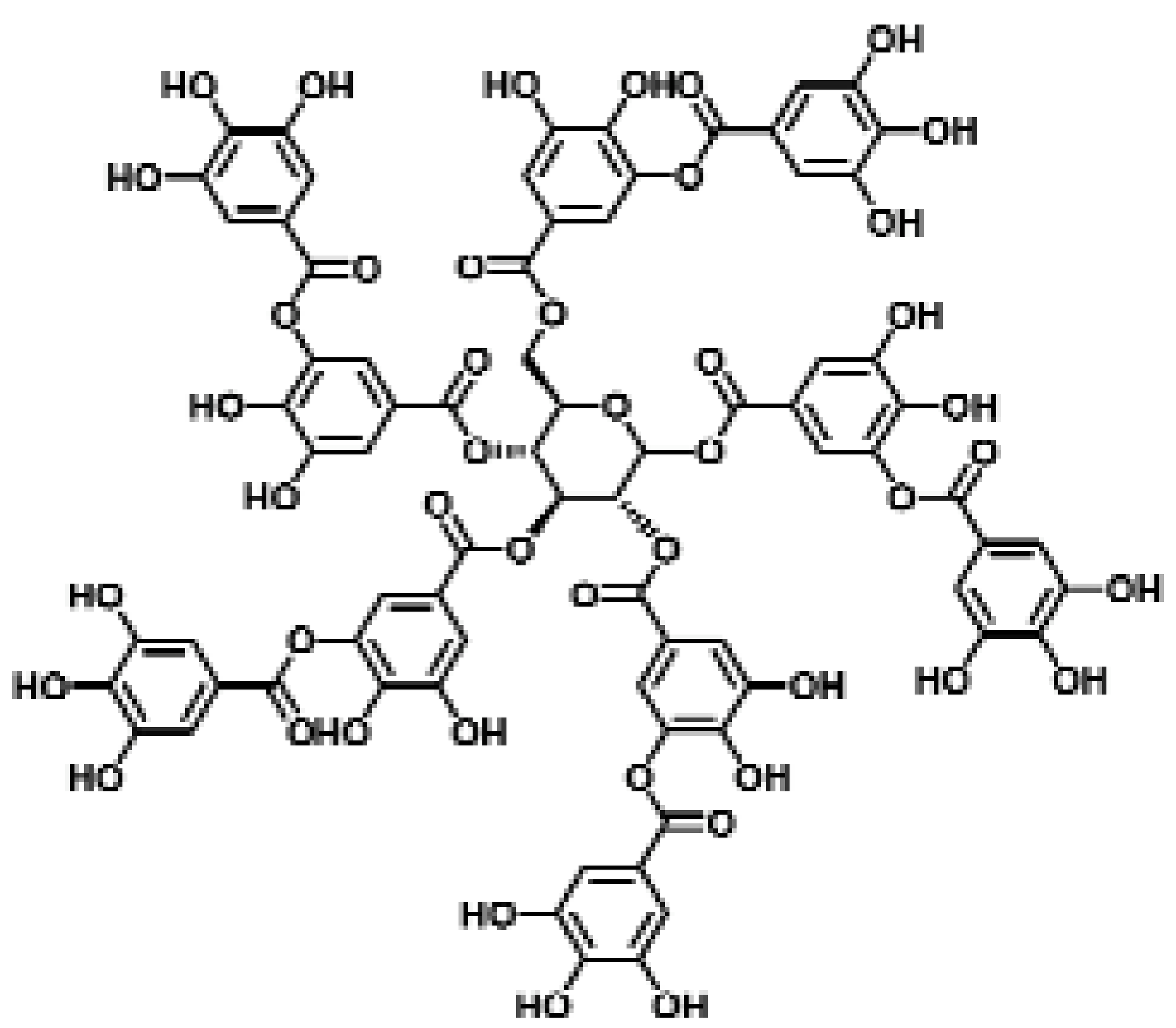

Fig. 2 – Tannic acid

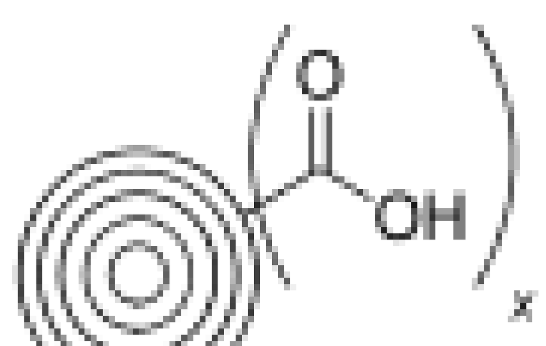

Fig. 3 – Oxidized carbon nanoonions

SYNTHESIS OF THE SENSING LAYER

The raw materials necessary for the synthesis of the sensitive layer are, in the first case, tannic acid (Sigma Aldrich), oxidized carbon nanohorns (Sigma Aldrich), deionized water, acetone, ethanol.

1) The Si/SiO_2 substrate is cleaned for 10 minutes in the ultrasonic bath using sequentially equal volumes of acetone, ethanol and finally deionized water.

2) The solution of tannic acid in water is prepared by dissolving 20 mg of biopolymer in 100 mL of deionized water, under magnetic stirring (10 minutes, at room temperature).

3) Subsequently, 80 mg of oxidized carbon nanohorns are added to the previously prepared solution and the magnetic stirring is continued for 60 minutes at room temperature.

4) The solution obtained is deposited by the "drop casting" method, using a Si / SiO_2 substrate with linear electrodes or interdigitated electrodes (after previously masking the contact area).

5) The obtained sensitive layer, deposited on the substrate, is dried in an oven at 50 °C in a vacuum for 30 minutes.

ADVANTAGES OF THE PROPOSED SENSING LAYER

The new synthesized sensing layer used in the manufacturing of resistive RH sensor have several significant advantages:

- the presence of CNHs-ox and CNOox ensures a high specific surface area / volume ratio as well as a substantial affinity for water molecules;
- tannic acid can form hydrogen bonds with both the hydrophilized substrate (Si/SiO_2) and oxidized carbon nanohorns
- detection at room temperature;
- rapid response.